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March 20, 1998

Magalie Roman Salas
Secretary
Federal Communications Commission
Room 222
1919 M Street, NW
Washington DC. 20554

In Re: WT Docket No. 96-86 - The Development of Operational, Technical, and Spectrum Requirements For Meeting Federal, State and Local Public Safety Agency Communication Requirements Through the Year 2010 and Establishment of Rules and Requirements For Priority Access Service

Dear Ms. Salas:

On March 19, 1998, representatives from Motorola met with staff members from the FCC's Wireless Telecommunications Bureau to discuss technical issues associated with the above captioned proceeding. Please associate this letter and the attached documents, which were referenced in the meeting, in the docket file for this proceeding.

Participating from the FCC were Kathryn Hosford, Herb Zeiler and Tom Stanley, all of the FCC's Wireless Telecommunications Bureau. The Motorola participants in the meeting were Emil Vogel, David Eierman, Ross Ruthenberg, Allen Davidson, Steve Jasper and Brad Hibben. I also attended the meeting.

The topics discussed during this meeting were all raised in Motorola's comments and reply comments filed in this proceeding. More specifically, the technical issues that were addressed included:

1. The amount of 746-806 MHz spectrum that will be immediately available for public safety use in the top 50 markets and the impact on that availability due to ultra-conservative sharing criteria between land mobile systems and broadcast TV stations.

2. The technical rationale for controlling adjacent channel interference and out of band emissions through direct measurement of *coupled power* rather than the traditional method of emission masks.

3. An overview of the technical characteristics of Motorola's proposed band plan. This discussion focused on the appropriate bandwidth of the basic channel for wideband and video applications.

4. An overview of the issues surrounding the suppression of harmonic emissions from public safety radios in the 746-806 MHz band to ensure interference protection to the Global Navigation Satellite System (GNSS) including the US Global Positioning System (GPS) and the Russian Federal Global Navigation Satellite System (GLONASS).

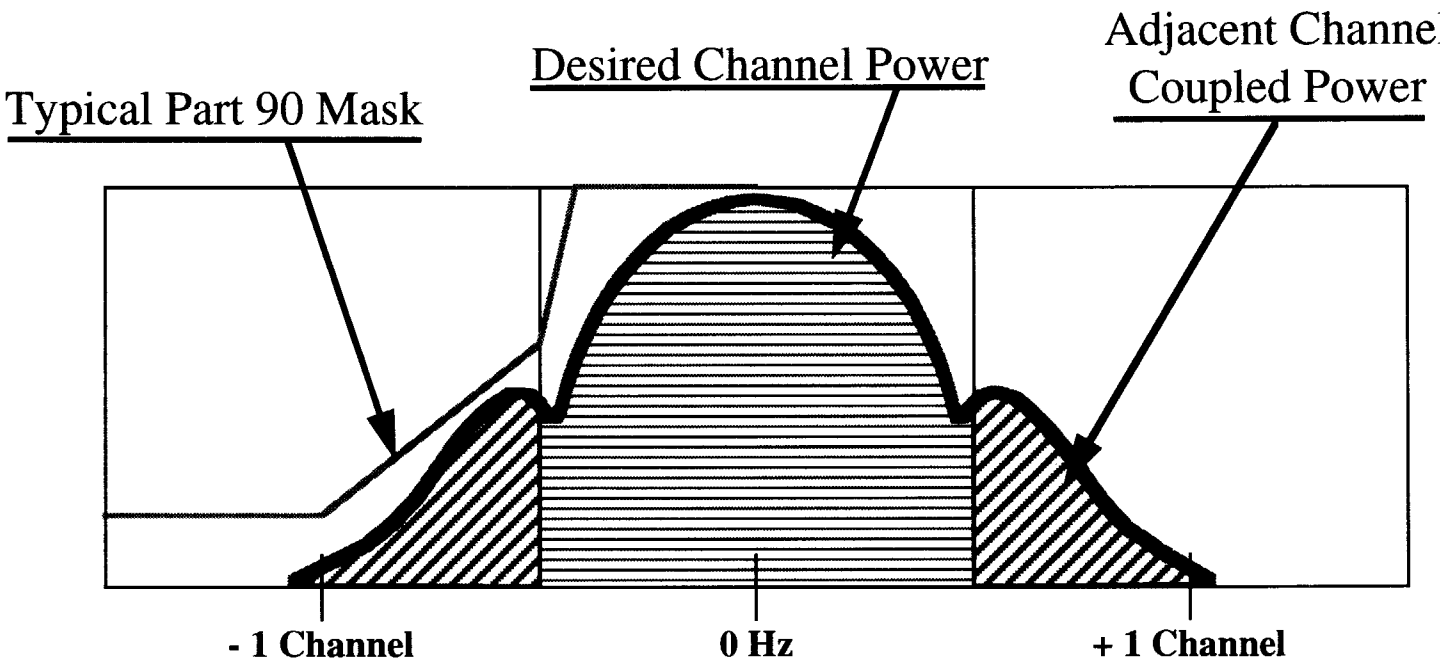
The attached slides were used to supplement these discussions. Thus, they should be incorporated in the record. Should you have any questions on this matter please contact me at (202) 429-7338.

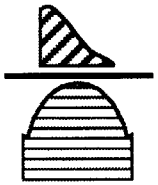
Sincerely,

Michael A. Lewis
Engineering Advisor
Wiley, Rein & Fielding

CC: Kathryn Hosford
Tom Stanley
Herb Zeiler

Adjacent Channel Coupled Power (ACCP)



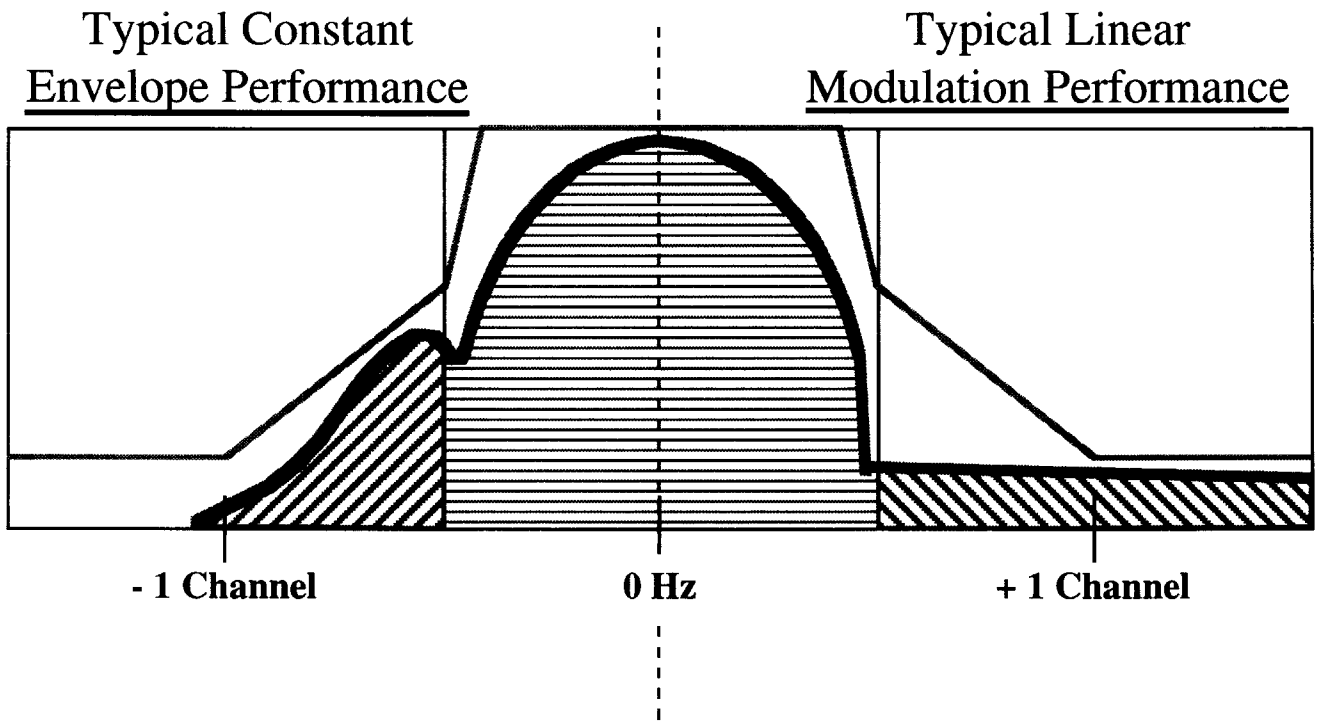
ACCP = 

This is an easy measurement to make with a modern spectrum analyzer!

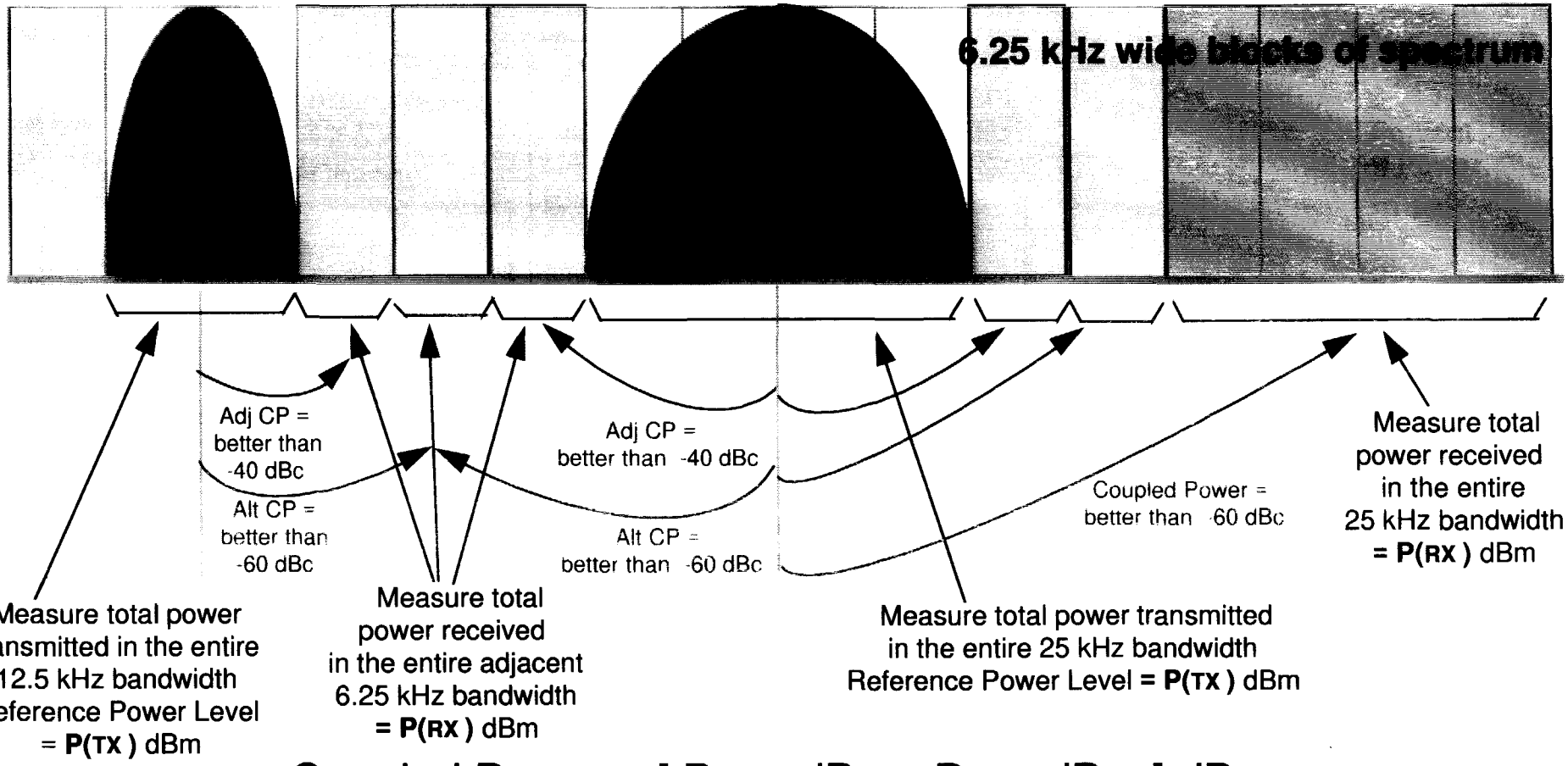
Why ACCP is Better Than an Emission Mask

- Signal quality (e.g. bit error rate) is a function of average signal/(noise+ interference) and this is what ACCP measures.
- The mask tends to focus on in-band performance; ACCP focuses on out-of-band performance.
- Masks make assumptions about receiver selectivity that can constrain system designs; ACCP gives the licensee complete use of his channel.
- We have had trouble with Masks in the past in interpreting how the various spectrum analyzer parameters affect actual interference level.
- Masks were reasonable for FM modulation, where out-of-band performance is well behaved; linear modulation is not necessarily so well behaved.

Linear/Constant Envelope Spectrum Comparison



Motorola Proposal
Power Coupled into a Specific Measurement Bandwidth



Coupled Power = [$P_{(RX)}$ dBm - $P_{(TX)}$ dBm] dBc

12.5 kHz Bandwidth Transmitter

Channel Center Offset	Measured Bandwidth	Coupled Pwr (@ max power)
adj = 9.375 kHz	6.25 kHz	-40 dBc
alt = 15.625 kHz	6.25 kHz	-60 dBc
21.875 kHz	6.25 kHz	-60 dBc
37.500 kHz	25 kHz	-65 dBc

25 kHz Bandwidth Transmitter

Channel Center Offset	Measured Bandwidth	Coupled Pwr (@ max power)
adj = 15.625 kHz	6.25 kHz	-40 dBc
alt = 21.875 kHz	6.25 kHz	-60 dBc
37.500 kHz	25 kHz	-60 dBc
62.500 kHz	25 kHz	-65 dBc

Integrated Voice/Data Mobile Station ACCP Table

6.25kHz Mobile Station Transmitter Requirements

Frequency Offset from Channel Center Frequency	Measurement Bandwidth	Max Coupled Power at Maximum Tx Power	Maximum Coupled Power Under Maximum Power Reduction
6.25 kHz	6.25 kHz	-40 dBc	-
12.5	6.25	-60	-45dBm
18.75	6.25	-60	-45
25	6.25	-65	-50
37.5	25	-65	-50
62.5	25	-65	-50
87.5	25	-65	-50
150	100	-65	-50
250	100	-65	-50
>400 to receive band	30 kHz *	-75	-55
In the receive band	30 kHz *	-100	-70

* Swept measurement

Determined by examining a high spec FM mobile

Would measure -73 dBc with 300 Hz resolution bandwidth

Determined by examining a high spec Linear mobile

Integrated Voice/Data Fixed Station ACCP Table

6.25kHz Fixed Station Transmitter Requirements

Frequency Offset from Channel Center Frequency	Measurement Bandwidth	Maximum Coupled Power
6.25 kHz	6.25 kHz	-40 dBc
12.5	6.25	-60
18.75	6.25	-60
25	6.25	-65
37.5	25	-60
62.5	25	-65
87.5	25	-65
150	100	-65
250	100	-65
>400 to receive band	30 kHz*	-80 (continues @-6dB/oct)
In the receive band	30 kHz*	-100

* Swept measurement

Can't do power control on a fixed station, so a cavity is added to reduce wideband noise

Wideband Mobile Station ACCP Table

100kHz Transmitter Requirements

Frequency Offset from Channel Center Frequency	Measurement Bandwidth	Max Coupled Power at Maximum Tx Power	Maximum Coupled Power Under Maximum Power Reduction
100kHz	~~50kHz~~ 100 kHz	~~-40dBc~~ -30dBc	-
200	~~50~~ 100	50	-35dBm
300	~~50~~ 100	-50	-35
400	~~50~~ 100	-50	-35
600 to 1MHz	30*	-60	-45
1MHz to receive band	30*	-70	-55
In the receive band	30*	-100	-75

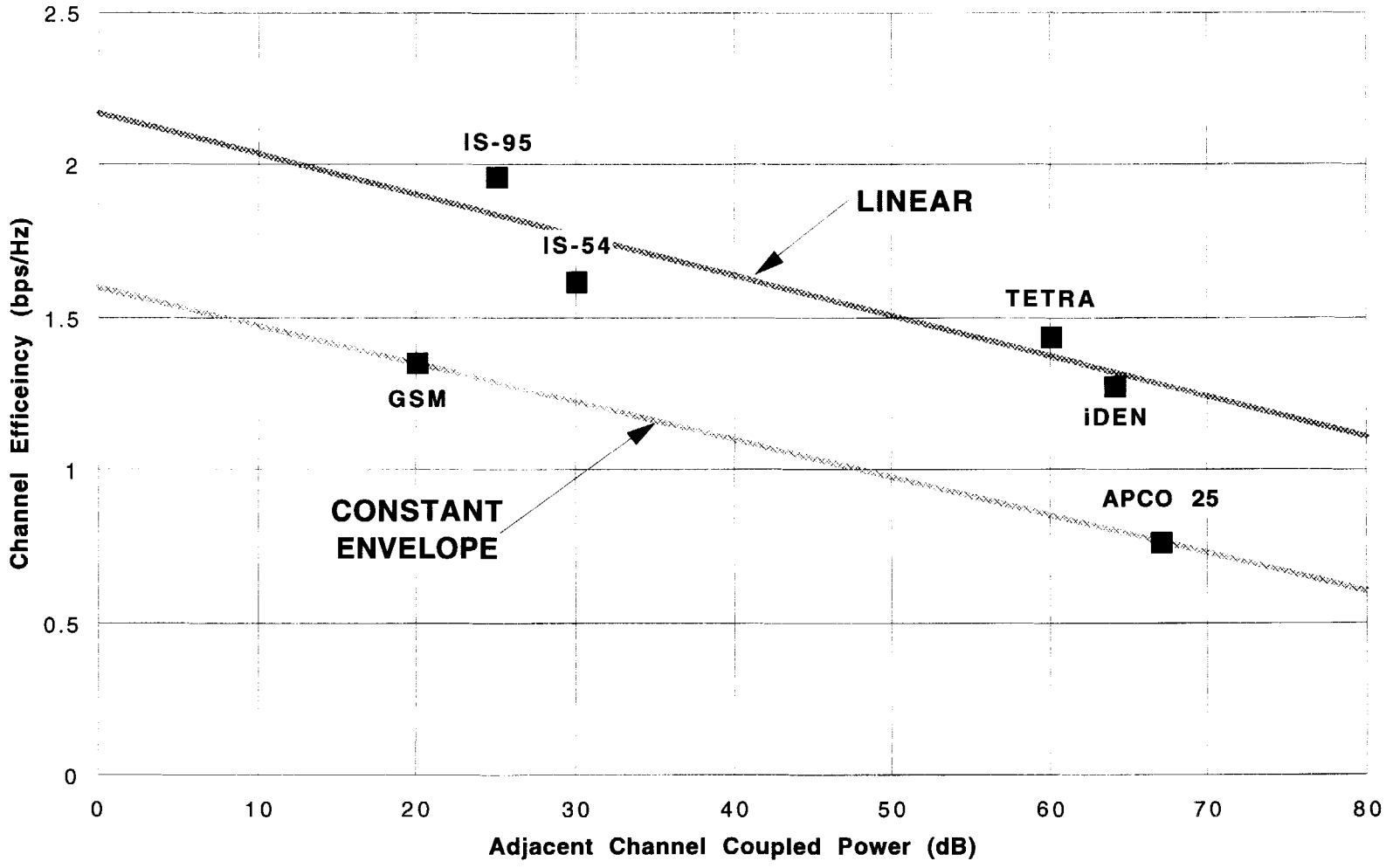
* Swept measurement

After further thought, this should really be 100 kHz

After further thought, -30 dBc is a better number for this

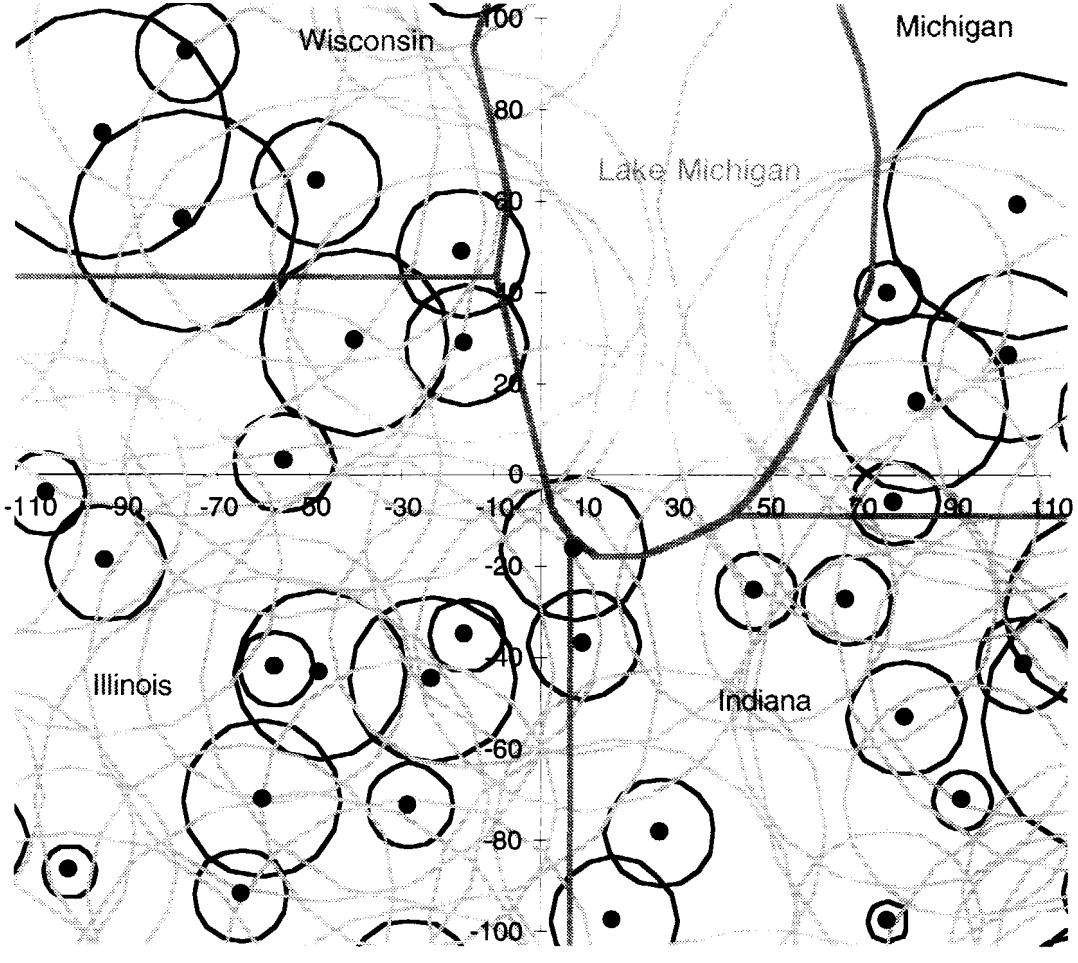
Reason for Proposing Adjacent Channel Coordination

Part 1: Efficiency is a function of ACCP



Reason for Proposing Adjacent Channel Coordination

Part 2: Maximizing Site Packing in Adjacent Channel Interference

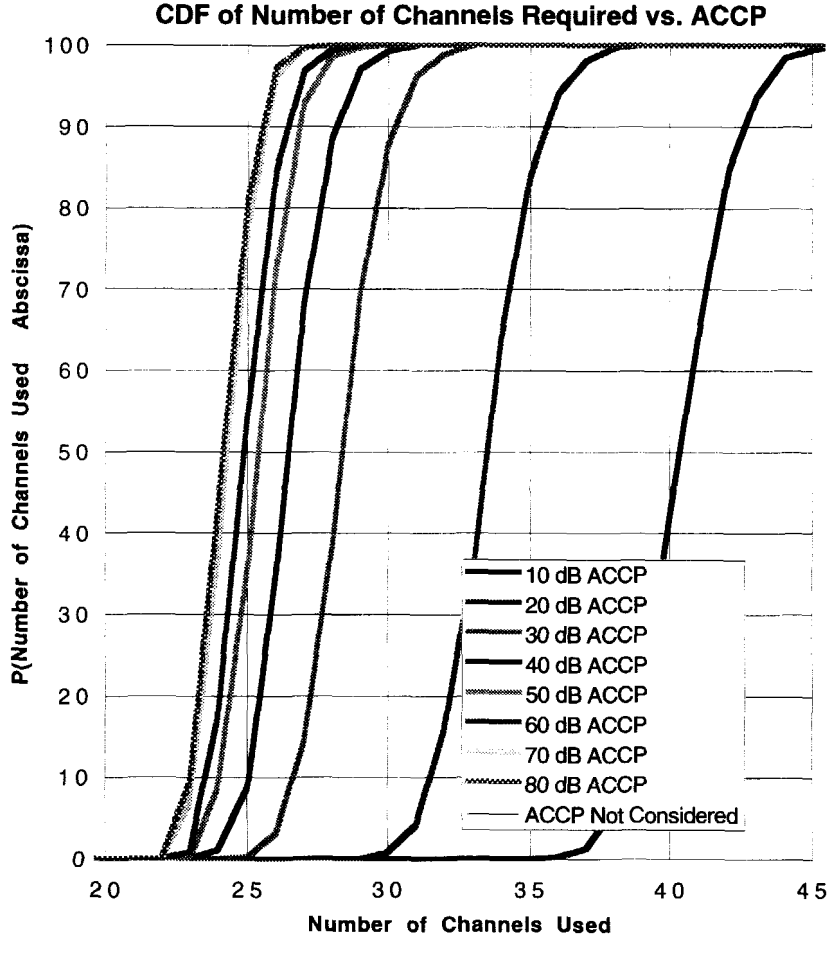


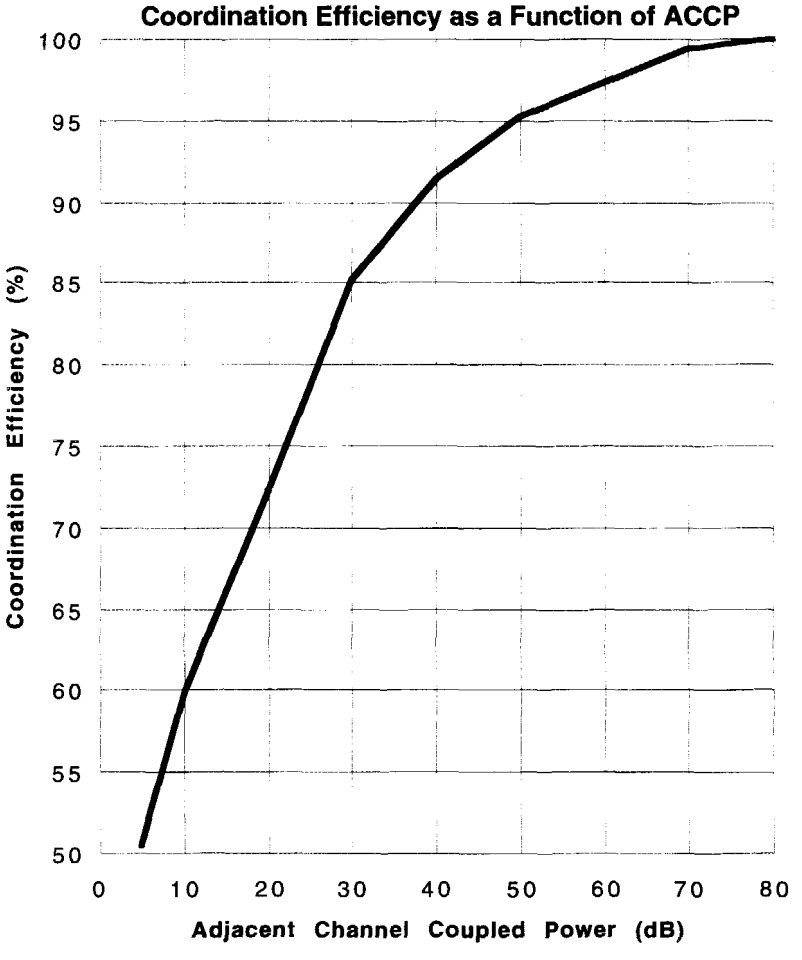
451.9 MHz in the
Special Industrial Service

- Site Location
- Coverage Contour
- Interference Contour
- Boundaries

Reason for Proposing Adjacent Channel Coordination

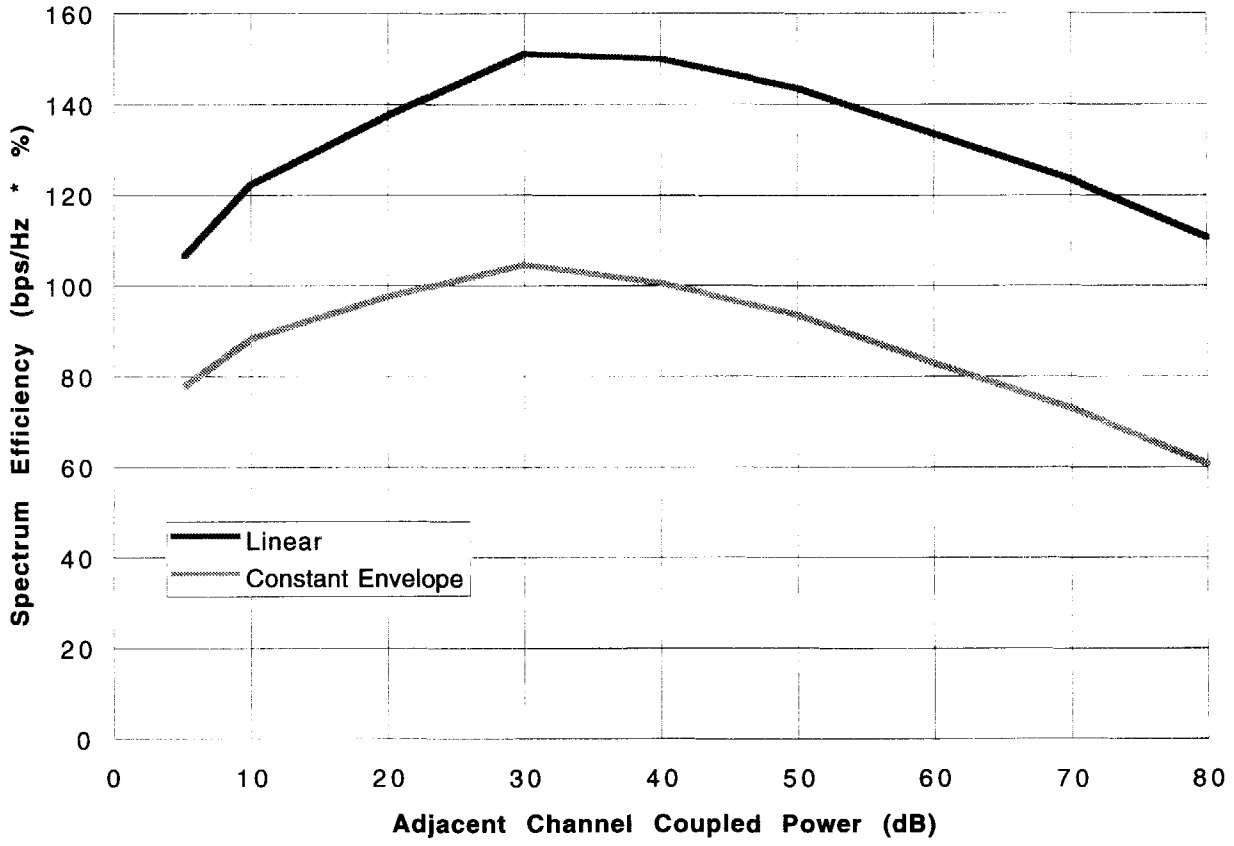
Part 2: Maximizing Site Packing in Adjacent Channel Interference





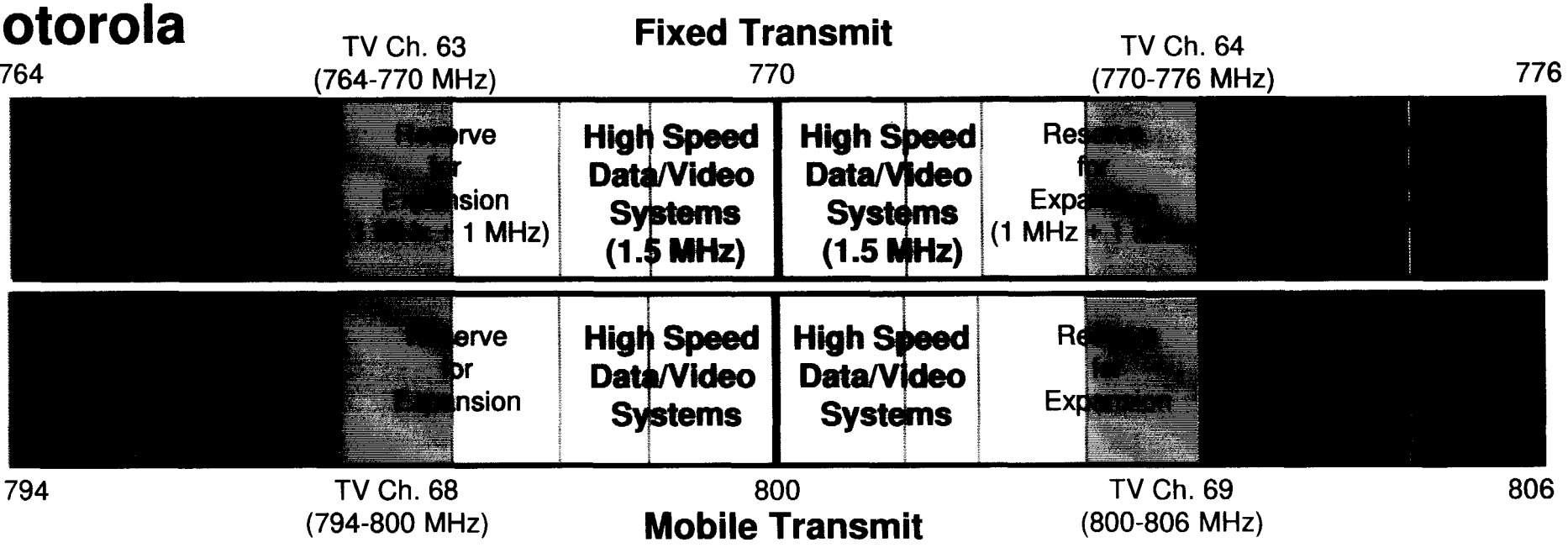
Reason for Proposing Adjacent Channel Coordination

Part 3: Maximizing Overall Spectrum Efficiency

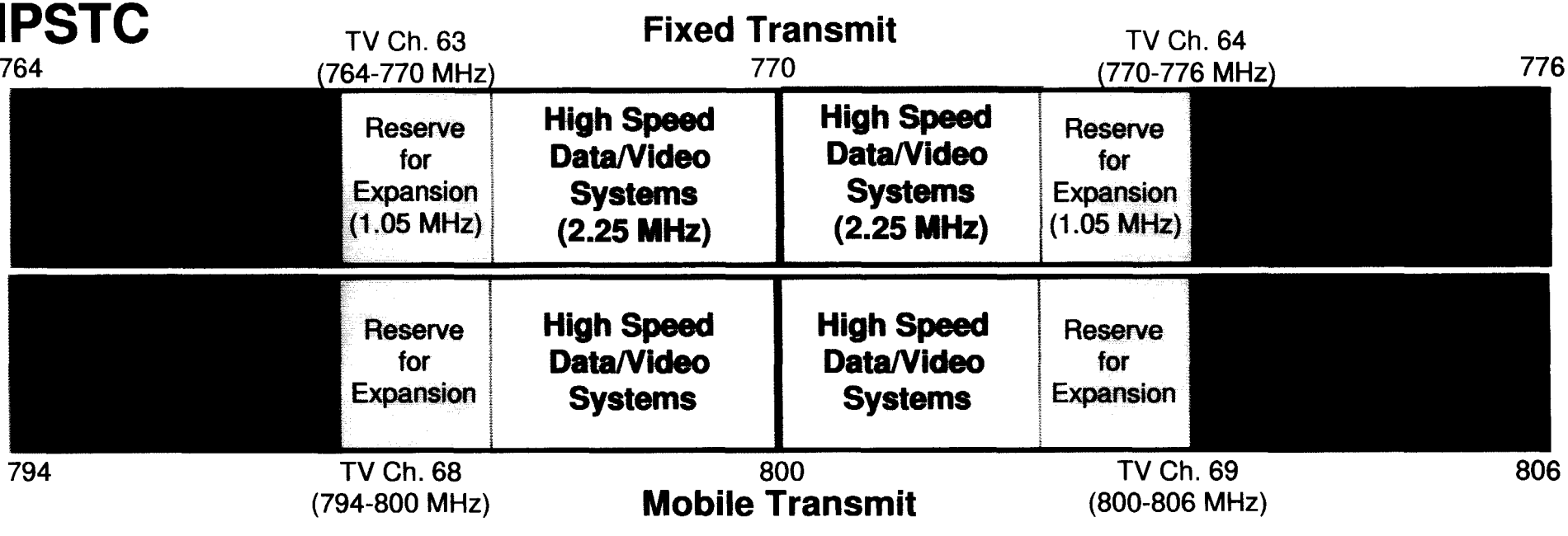


Spectrum Efficiency = Channel Efficiency * Coordination Efficiency

Motorola



NPSTC



NPSTC 746-806 MHz Plan in each TV Channel Pair

	NPSTC	Motorola Comparison
• Wideband data/digital video channels	3.60 MHz	3.00 MHz
– 12 general usage pairs	multiples of	multiples of
– paired, 150 kHz bandwidth, >= 384 kbps data rate	150 kHz	100 kHz
• Medium bandwidth data channel	0.30 MHz	
– 6 general usage pairs	6 x 25 kHz pairs	
• paired, 25 kHz bandwidth, >= 19.2 kbps data rate		
• split out from 1 additional 150 kHz wideband data channel		
• Integrated voice and data channels	5.00 MHz	4.75 MHz
• 200 pairs, 12.5 kHz bandwidth	200 x 12.5 kHz	380 x 6.25 kHz
• voice or <= 9.6 kbps data	pairs	pairs
– 144 general usage		
– 40 Regional or Statewide usage		
– 10 Statewide usage		
– 6 Vehicular Repeater and/or Simplex channels		
• Interoperability (see next slide)	1.00 MHz	0.25 MHz 20 x 6.25 kHz pairs
• Reserve	2.10 MHz	4.00 MHz 2 MHz voice + 2 MHz Data

NPSTC Interoperability Channels in each TV Channel Pair

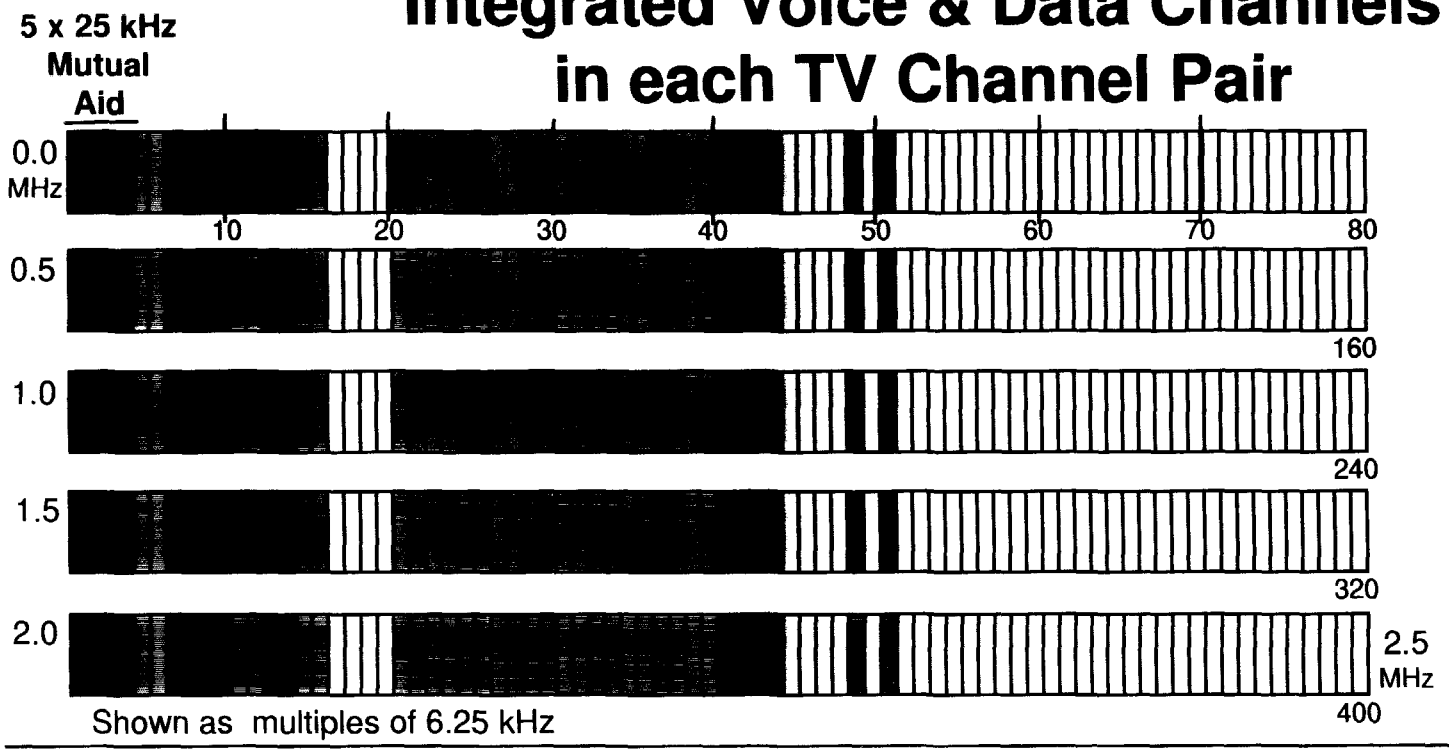
	NPSTC	Motorola Comparison
• 1 wideband digital video channel	0.30 MHz	
• paired, 150 kHz bandwidth, >= 384 kbps data rate		
• 1 wideband data channel	0.30 MHz	
• paired, 150 kHz bandwidth, >= 384 kbps data rate		
• 10 integrated voice/data channels	0.25 MHz	0.25 MHz
• paired, 12.5 kHz bandwidth, voice or <= 9.6 kbps data	10 x 12.5 kHz pairs	1st four 6.25 kHz pairs in each 500 kHz block (5 x 25 kHz)

– 1 coordination channel (open to Public Safety & Public Service)
– 1 EMS channel
– 1 Fire channel
– 1 Law Enforcement channel
– 1 Public Safety/Public Service shared channel
– 5 tactical channels

• 12 simplex for tactical operations	0.15 MHz

– 3 Public Safety/Public Service shared 12.5 kHz tactical freq's
– 9 Public Safety 12.5 kHz tactical frequencies

Integrated Voice & Data Channels in each TV Channel Pair



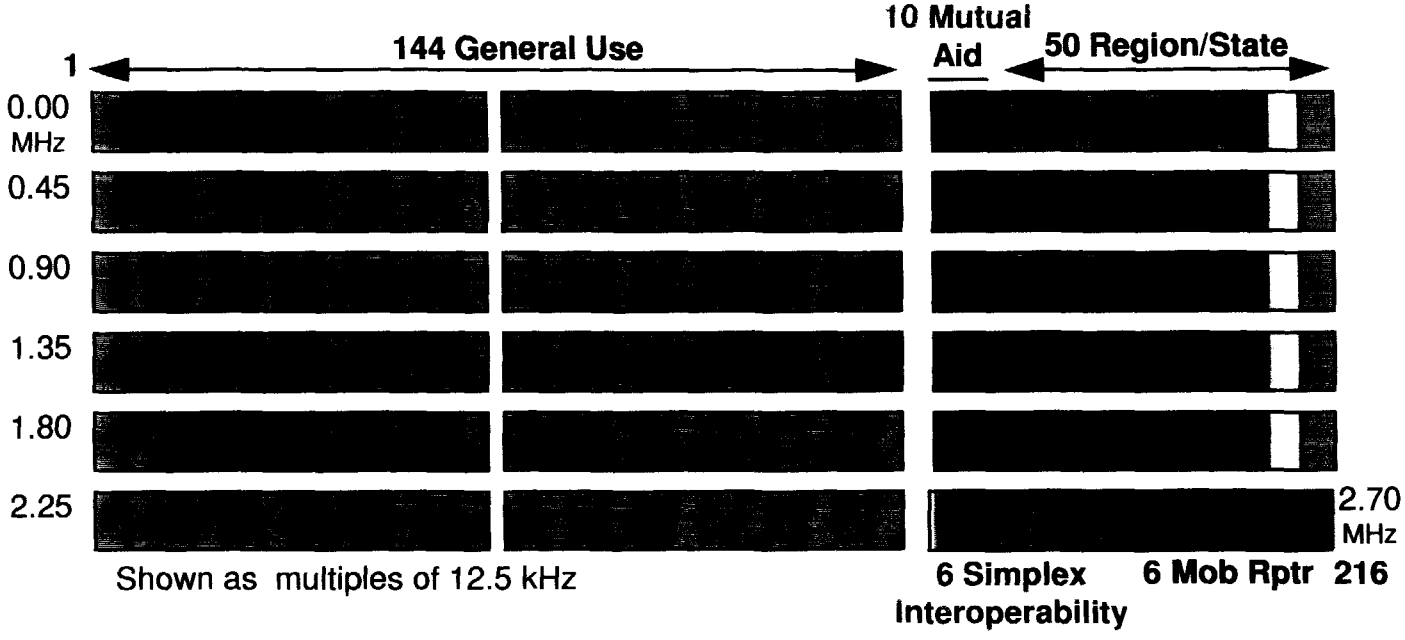
Motorola

Five 500 kHz Blocks (1/2 pair)
= 5 x 80 x 6.25 kHz = 2.5 MHz

Interop/Mutual Aid
1st four 6.25 kHz blocks in each 500 kHz block (250 kHz)

Same channel in each 500 kHz block grouped to form multi-channel system.
Use alternate channels for subsequent blocks of channels to be co-located

Aggregate multiple 6.25 kHz blocks into 12.5 or 25 kHz bandwidth blocks



NPSTC

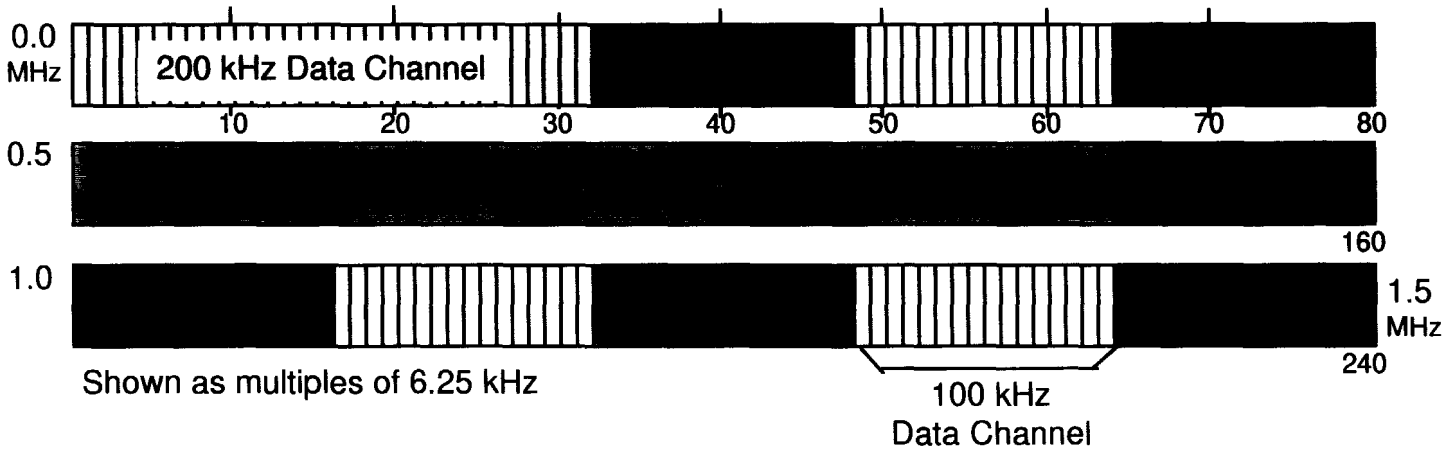
Six 450 kHz Blocks (1/2 pair)
= 6 x 36 x 12.5 kHz = 2.7 MHz

Interop/Mutual Aid
Two 12.5 kHz blocks in first five 450 kHz blocks plus six 12.5 kHz blocks
= 10 Interoperability (250kHz)
= 12 on-scene simplex (150 kHz)

Same channel in each 450 kHz block grouped to form multi-channel system.

Aggregate multiple 12.5 kHz blocks into 25 kHz block

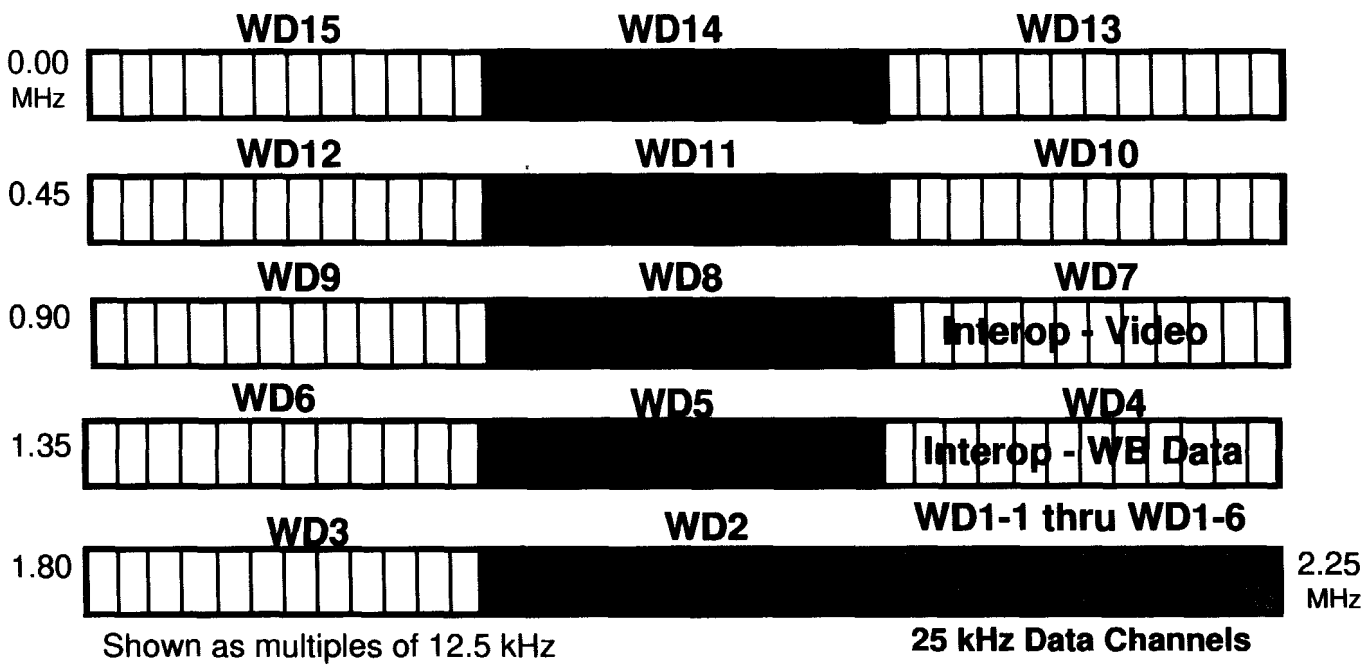
Data Channels in each TV Channel Pair



Motorola

Fifteen 100 kHz bandwidth blocks

Aggregate multiple blocks for 200 & 400 kHz bandwidth blocks



NPSTC

Fifteen 150 kHz bandwidth blocks

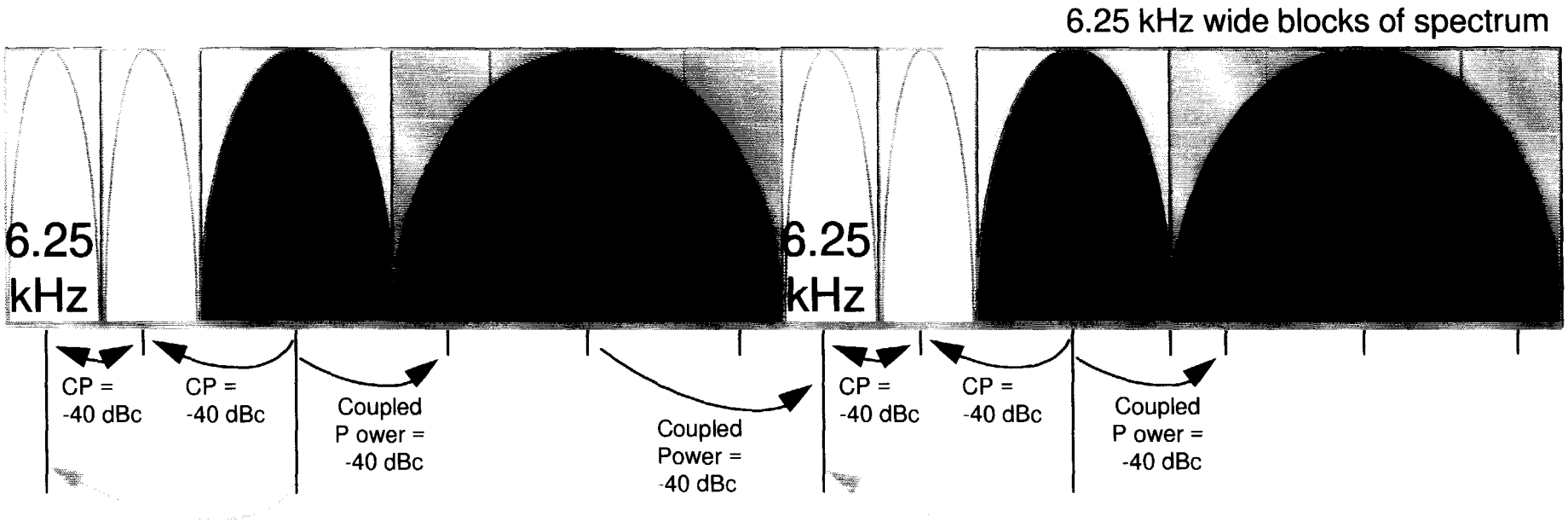
12 - 150 kHz data channels

1 - 150 kHz interoperability video channel

1 - 150 kHz interoperability data channel

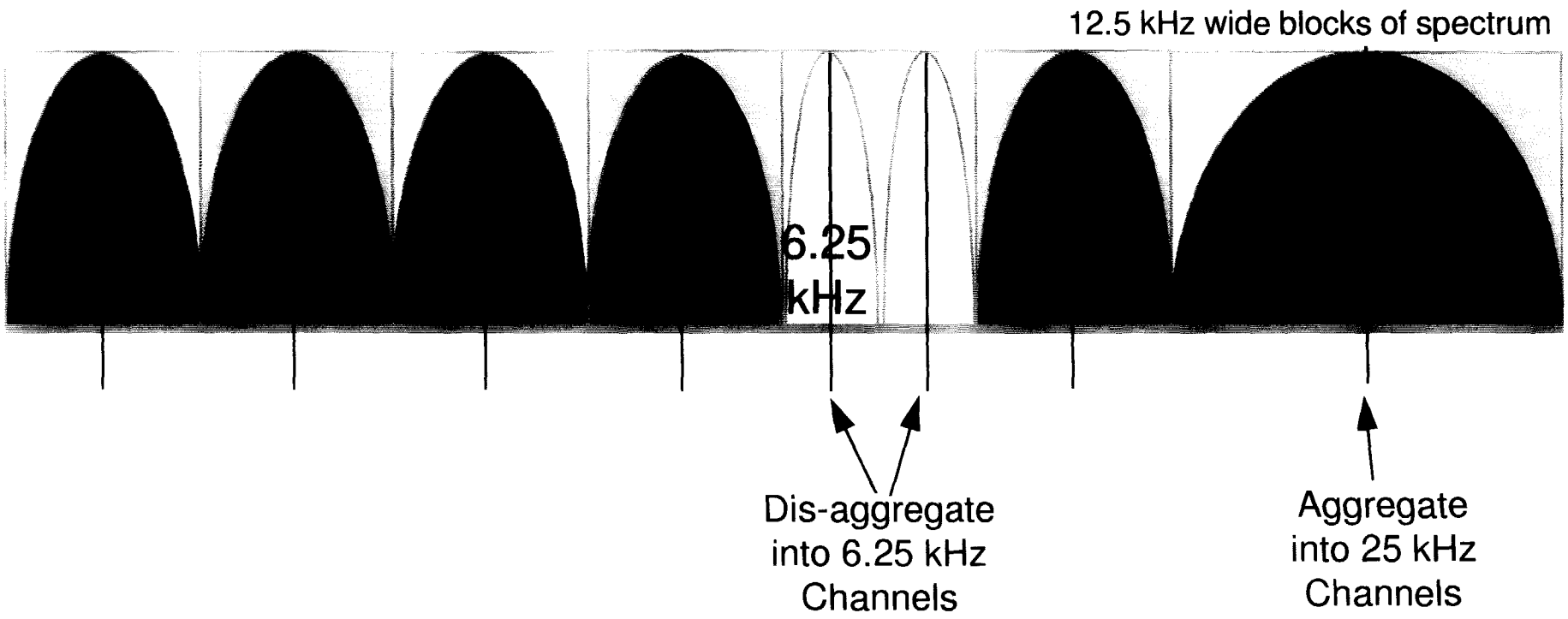
6 - 25 kHz data channels

Motorola Proposal



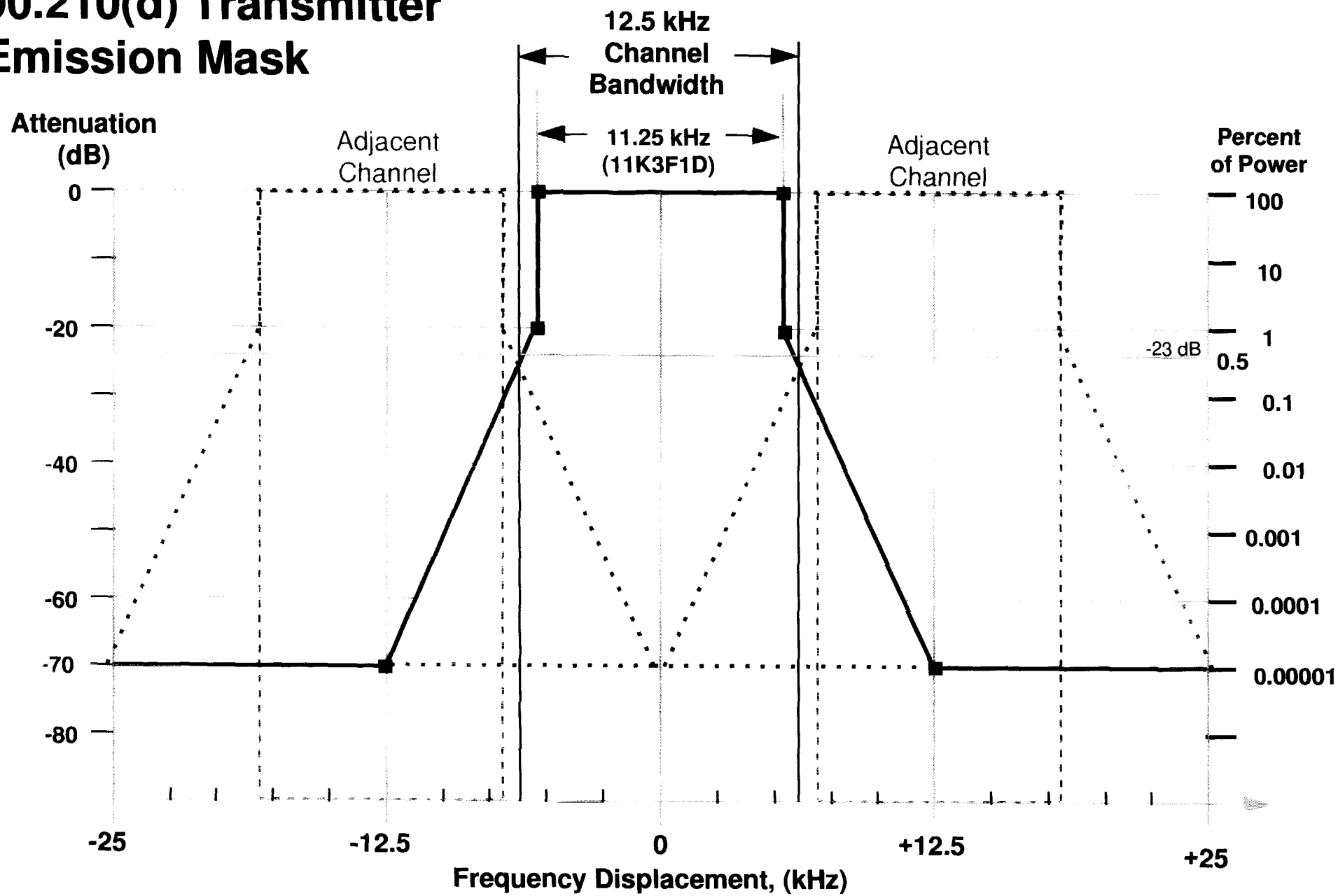
- 6.25 kHz wide blocks of spectrum
- can aggregate adjacent 6.25 kHz blocks into wider channels
- center modulation within channel
- all channels have same out-of-band emission level into the 6.25 kHz block adjacent to the edge of the channel
    - coupled power measured in adjacent 6.25 kHz channel bandwidth better than 40dB below power measured in transmitter channel bandwidth
- out-of-band emission into alternate 6.25 kHz block better than -60 dBc
- adjacent channels probably require some geographic separation
- wideband data and video in multiples of 100 kHz blocks
    - coupled power = better than -40dBc into adj 50 kHz block

NPSTC Proposal

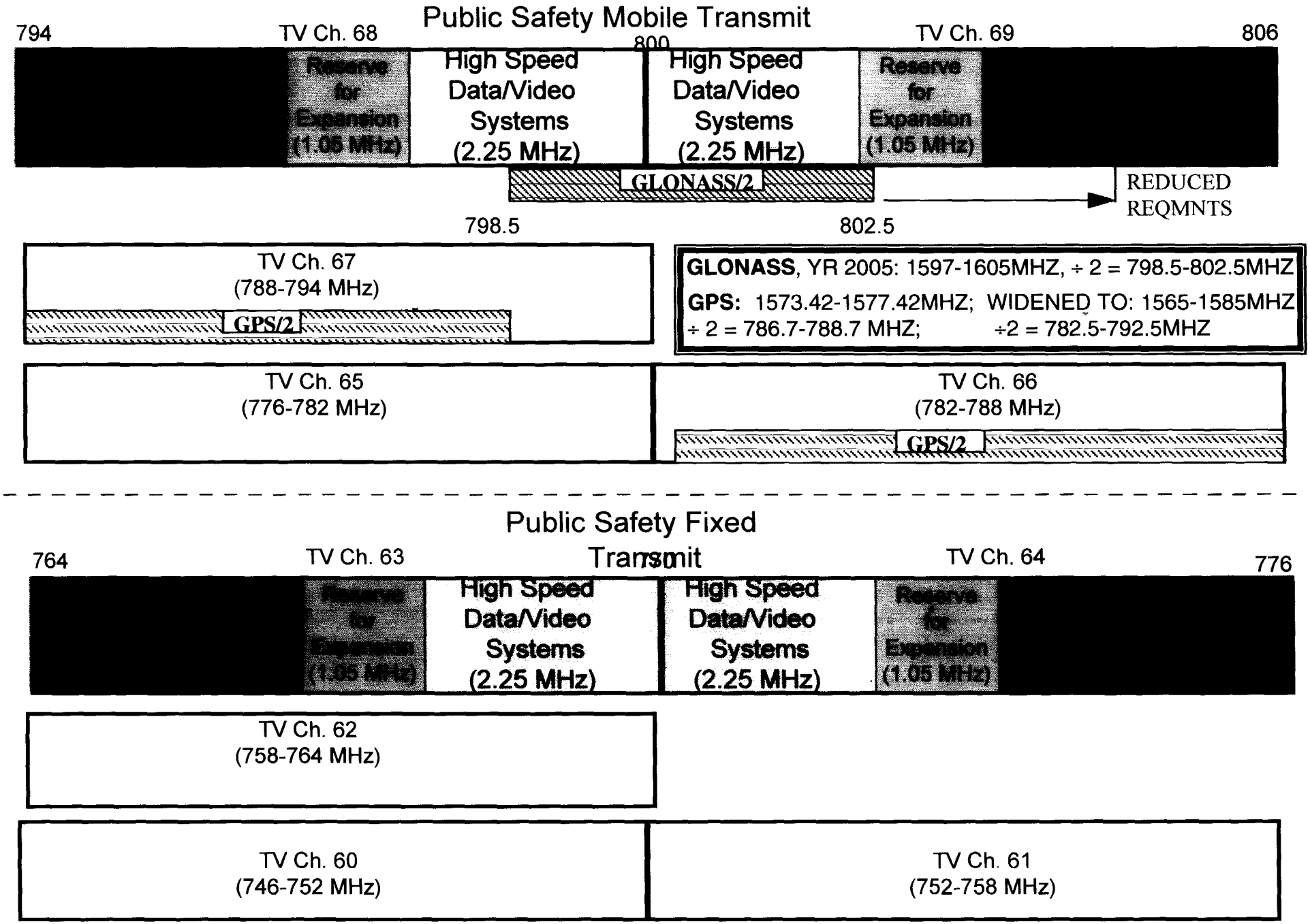


- 12.5 kHz wide channels
- can aggregate adjacent 12.5 kHz channels into wider channels
- can dis-aggregate 12.5 kHz channels into narrower channels
- center modulation on channel center
- use VHF/UHF refarming Mask D
- wideband data and video in multiples of 150 kHz blocks

NPSTC Proposal 90.210(d) Transmitter Emission Mask



100 Hz Resolution Bandwidth


Public Safety Mobile Transmit
794
TV Ch. 68
800
TV Ch. 69
806
Reserve for Expansion (1.05 MHz)
High Speed Data/Video Systems (2.25 MHz)
High Speed Data/Video Systems (2.25 MHz)
Reserve for Expansion (1.05 MHz)
GLONASS/2
REDUCED REQMNTS
798.5
802.5
TV Ch. 67
(788-794 MHz)
GPS/2
GLONASS, YR 2005: 1597-1605MHZ, ÷ 2 = 798.5-802.5MHZ
GPS: 1573.42-1577.42MHZ; WIDENED TO: 1565-1585MHZ
÷ 2 = 786.7-788.7 MHZ; ÷2 = 782.5-792.5MHZ
TV Ch. 65
(776-782 MHz)
TV Ch. 66
(782-788 MHz)
GPS/2
Public Safety Fixed Transmit
764
TV Ch. 63
TV Ch. 64
776
Reserve for Expansion (1.05 MHz)
High Speed Data/Video Systems (2.25 MHz)
High Speed Data/Video Systems (2.25 MHz)
Reserve for Expansion (1.05 MHz)
TV Ch. 62
(758-764 MHz)
TV Ch. 60
(746-752 MHz)
TV Ch. 61
(752-758 MHz)

PUBLIC SAFETY GLONASS/GPS 2ND HARMONIC ISSUES

- OPERATING P.S. CARRIER 2ND HARMONIC IS GLONASS RELATED, NOT GPS; PRIMARY IMPACT ON WB DATA/VIDEO SERVICES.
- DIRECT UNIT-UNIT COMMUNICATIONS REQMNTS ("TALK-AROUND") REQUIRE PORTABLES TO TRANSMIT ON 68/69, INDEPENDANT OF BASE TRANSMIT FREQUENCY LOCATION.
- EMISSIONS REQUIREMENTS:
  - FCC: -13DBM CONDUCTED.
  - "TOUGH" EURO: -36DBM CONDUCTED.
  - FAA: -50DBM RADIATED.
    [EQUIVALENT TO ABOUT -56DBM CONDUCTED.]
- CURRENT MANUFACTURER VIEW:
  - -56DBM FEASIBILITY UNKNOWN. IF FEASIBLE, RADIO COST INCREASE OF ABOUT $100-$300 EACH; INCREASED BATTERY DRAIN; INCREASED SIZE.
- MSS CONCLUSION IN RTCA/DO-235: FAA REQUIREMENTS ARE AT LEAST 16DB TO CONSERVATIVE.....

PUBLIC SAFETY GLONASS/GPS 2ND HARMONIC ISSUES

- GPS REQUIREMENTS STILL A (LESSER) CONCERN RE. NON-CARRIER 2ND HARMONIC [e.g. (CARRIER-SPUR)*2]
- RTCA/FAA REPORT SEEMS NOT TO RECOGNIZE RADIATION POTENTIAL FROM HOUSINGS/CASINGS/ACCESSORIES..... ..WORLDS BEST TRANSMITTER PORT FILTER DOESN'T SOLVE.